# Transactions of American Society for Metals

# Volume XL 1948

Ray T. Bayless Editor



Published by
American Society for Metals
7301 Euclid Ave.
Cleveland 3, Ohio

Copyright 1948 by the American Society for Metals Cleveland, Ohio

Printed in U. S. A.

Foot engin. Foton 4.

# Contents

Technical Program and Reports of Officers, ASM 29th Annual Convention, Chicago, October 18 to 24, 1947	1 27
The Physical Chemistry of Acid Refining Process— By Yap, Chu-Phay Discussion	83 109
Some Fundamental Factors Involved in Intermittent Metal Cutting Processes, With Special Reference to Shaping—	
By K. J. B. Wolfe	120 143 160
The Heat Treatment and Properties of Some Beryllium-Nickel Alloys—By W. Lee Williams	163 175
Stretching Characteristics of Aluminum Alloy Sheet—By J. M. Taub Discussion	180 207
Effect of Sixteen Alloying Elements Upon the Grain Size of Cast 4.5% Copper-Aluminum Alloy—By Harold G. Bowen, Jr., and Harold Bernstein	209
By H. A. Schwartz and James Hedberg	223
Discussion Graphitization of Steel at Elevated Temperatures— By A. B. Wilder and J. D. Tyson	230 233
Discussion Alloy Spring Steels—By E. T. Bittner	249 263
An Investigation of Tempered Chromium-Silicon Spring Steel— By H. J. Elmendorf Discussion	281 298
Tempering Effects and the Mechanical Equation of State— By J. C. Fisher and C. W. MacGregor Discussion	302 312
Concept of the Hydrogen Potential in Steam-Metal Reactions— By Carl A. Zapffe	315
Discussion The Damping Capacity of Copper-Manganese Alloys— By R. S. Dean, E. V. Potter, R. W. Huber and H. C. Lukens	352 355
The Electrical Resistivity and Temperature Coefficient of Resistance of Copper-Manganese Alloys— By R. S. Dean, E. V. Potter and R. W. Huber	381
Iron-Manganese Alloys—Properties of Cold-Worked and Normalized Alloys Containing 26 to 48% Manganese—	301
By J. R. Long, T. R. Graham and A. H. Roberson	401
Discussion The Bend Test for Hardened High Speed Steel—	427
By Arthur H. Grobe and George A. Roberts  Discussion  Effects of Grinding on Physical Properties of Hardened Steel	435 471
Parts—By Howard E. Boyer  Discussion  Elimination of Shatter Cracks by Hot Working—	491 <b>504</b>
By E. L. Koehler and H. B. Wishart	513
—Part I—By Howard S. Avery and Charles R. Wilks  Discussion  The Cobalt-Chromium J Alloy at 1350 to 1800 °F—	529 577
By Nicholas J. Grant	585 610

The Effect of Silicon on the Properties of Cast Carbon and Carbon- Molybdenum Steels—	
By N. A. Ziegler, W. L. Meinhart and J. R. Goldsmith	617 647
Discussion The Effect of Homogenization on Cast Steels— By R. J. Marcotte and C. T. Eddy	649
Discussion  Detection of As-Cast Austenite Grain Size in Heat Treated Cast Alloy Steels—By Edward A. Loria	674 677
Discussion The Dimensional Stability of Steel. Part II—Further Experiments	691
on Subatmospheric Transformations— By S. G. Fletcher, B. L. Averbach and M. Cohen Discussion	703 720
The Dimensional Stability of Steel. Part III—Decomposition of Martensite and Austenite at Room Temperature—	
By B. L. Averbach, M. Cohen and S. G. Fletcher  Discussion  Acicular Transformations in Alloy Steel—	728 754
By E. A. Loria and H. D. Shephard	758 774
Discussion Influence of Metallurgical Factors on the Mechanical Properties of Steel—By S. A. Herres and C. H. Lorig	775
Mechanical Properties of Metals at Low Temperatures; A Survey—	805
By L. Seigle and R. M. Brick	813 861
By E. Epremian and E. F. Nippes Discussion	870 888
Macrosegregation in Some Alloy Steel Ingots—By J. W. Spretnak Discussion  The Distribution of Oxygen and Nitrogen in an Alloy Steel Ingot—	897 916
By C. F. Sawyer, J. W. Spretnak and G. Derge	922
By W. T. Rogers Discussion	935 950
A New Design of Microhardness Tester and Some Factors Affecting the Diamond Pyramid Hardness Number at Light Loads— By R. F. Campbell, Q. Henderson and M. R. Donleavy	954
Metallography of Hot-Dipped Galvanized Coatings— By D. H. Rowland	983
Induction Hardening of a Quality Controlled Iron—	
By C. F. Walton and H. B. Osborn, Jr.  Discussion  Some Factors Affecting the Induction Hardening of an Alloy Cast	1012 1026
Iron—By J. R. Sloan and R. H. Hays	1036
A Study of the Metallurgical Characteristics of Three Induction- Hardened Steels Heated at Various Rates— By James W. Poynter	1077
Discussion	1093
Steels—By G. D. Rahrer and C. D. Armstrong	1099 1112
Influence of Nitrogen on the Hardenability and Notch Toughness of Boron-Treated Steels— By Thomas G. Digges and Fred M. Reinhart	1124
Some Characteristics of the Metastable Austenite of 4 to 6% Chromium + 1/2% Molyhdenum Cast Steel—	
By Glen J. Guarnieri and J. J. Kanter	1147

# AMERICAN SOCIETY for METALS

# Officers and Trustees

F. B. FOLEY, President
The Midvale Co., Nicetown, Philadelphia

E. L. SPANAGEL, Treasurer Rochester Gas & Electric Co., Rochester

H. K. WORK, Vice-President Jones & Laughlin Steel Corp., Pittsburgh

> W. H. EISENMAN, Secretary 7301 Euclid Ave., Cleveland

## TRUSTEES

## A. L. BOEGEHOLD, Past President General Motors Corp., Detroit

C. M. CARMICHAEL Shawinigan Chemicals, Montreal

A. E. FOCKE
Diamend Chain & Manufacturing Co.
Indianapolis

JOHN E. DORN University of California, Berkeley

> E. G. MAHIN University of Notre Dame Notre Dame, Ind.

#### PAST PRESIDENTS

ALBERT E. WHITE1921	В. Г. Shepherd1935
Frank P. Gilligan1922	R. S. Archer1936
*TILLMAN D. LYNCH	E. C. BAIN1937
*George K. Burgess1924	G. B. Waterhouse1938
*WILLIAM S. BIDLE1925	W. P. WOODSIDE1939
*Robert M. Bird1926	J. P. Gill1940
J. FLETCHER HARPER1927	O. E. HARDER1941
FREDERICK G. HUGHES1928	BRADLEY STOUGHTON1942
ZAY JEFFRIES1929	H. J. French
*R. G. GUTHRIE1930	M. A. GROSSMANN1944
J. M. WATSON1931	K. R. VAN HORN1945
A. H. D'ARCAMBAL	C. H. HERTY, JR1946
WILLIAM B. COLEMAN	А. L. Воеденовр1947
*WILLIAM H. PHILLIPS1934	

#### FOUNDER MEMBERS

*THEODORE E.	BARKER	*ARTHUR G.	HENRY	WILLIAM P. V	VOODSIDE, Detroit
ALBERT	E. WHIT	E, Ann Arbor	W.	H. EISENMAN,	Cleveland

#### HONORARY MEMBERS

*Charles F. Brush, Sc. D  *Edward DeMille Campbell.  *Henry Le Chatelier.  *Thomas Alva Edison, Sc. D  *Judge Elbert H. Gary.  *Sir Robert Hadfield, Bart., F. R. S.  *Elwood Haynes  Kotaro Honda, Sc. D	ZAY JEFFRIES, Sc. D

<sup>\*</sup>Deceased.

# AMERICAN SOCIETY for METALS

# HENRY MARION HOWE MEDALISTS EMANUEL J. JANITZKY 1922 FRANCIS F. LUCAS 1924 HORACE H. LESTER 1925 .1922 \*Frederick C. Langenberg. 1926 Wesley P. Sykes. 1927 \*CARL R. WOHRMAN......1929 M. A. GROSSMANN, M. ASIMOW and S. F. URBAN......1941 \*Albert Sauveur 1934 B. F. Shepherd 1942 Zay Jeffries 1935 C. H. Herty, Jr. 1943 W. R. Chapin 1936 Walter E. Jominy 1944 H. W. McQuaid 1938 R. S. Archer 1945 \*S. P. Rockwell 1939 E. C. Bain 1946 A. W. Machlet 1940 F. P. Zimmerli 1947 \*A. L. Marsh 1941 SAUVEUR ACHIEVEMENT AWARD GOLD MEDAL OF A. S. M. EARLE C. SMITH......1945 A. S. M. MEDAL FOR THE ADVANCEMENT OF RESEARCH CAMPBELL MEMORIAL LECTURERS Wesley P. Sykes. 1937 Alfred L. Boegehold. 1938 Edmund S. Davenport. 1939 Samuel L. Hoyt. 1940 Robert F. Mehl. 1941 John Chipman. 1942 C. H. Mathewson. 1943 George R. Fitterer. 1944 Maxwell Gensamer. 1945 James B. Austin. 1946 Augustus B. Kinzel. 1947 William M. Guertler..... 1926 William M. Guertler 1926 Zay Jeffries 1927 \*W. H. Hatfield 1928 \*Albert Sauveur 1929 Marcus A. Grossmann 1930 Charles H. Herty, Jr. 1931 Edgar C. Bain 1932 Herbert J. French 1933 Vsevolod N. Krivobok 1934 Harry W. McQuaid 1935 James P. Gill 1936

# AMERICAN SOCIETY for METALS

# Standing Committees

#### FINANCE COMMITTEE

E. L. SPANAGEL, Chairman Rochester Gas & Electric Co. Rochester, N. Y. Members:\*
L. E. Ekholm, Philadelphia, '48
Zay Jeffries, Cleveland, '50
A. W. Mace, Washington, '50
E. H. Stilwill, Detroit, '50
K. R. Van Horn, Cleveland, '49
Clyde Williams, Columbus, '48

## CONSTITUTION AND BY-LAWS COMMITTEE

D. D. BEACH, Chairman, '48 Atlanta Gas Light Co. Atlanta, Ga. Members:
R. F. Harvey, Rhode Island, '48
A. S. Jameson, Chicago, '50
Milo Stutzman, Kansas City, '49
W. W. Wight, Hartford, '50
A. E. Focke, Rep. of ASM Board of Trustees

#### PUBLICATIONS COMMITTEE

A. O. SCHAEFER, Chairman, '48 Midvale Co. Nicetown, Philadelphia

RAY T. BAYLESS, Secretary 7301 Euclid Ave. Cleveland 3 Members:
R. H. Aborn, New Jersey, '48
C. T. Evans, Jr., Northwest Penn., '50
A. L. Feild, Baltimore, '48
M. G. Fontana, Columbus, '50
J. H. Hollomon, Schenectady, '49
H. B. Osborn, Jr., Cleveland, '48
W. A. Pennington, Syracuse, '50
F. N. Rhines, Pittsburgh, '49
E. S. Rowland, Canton-Mass., '48
L. E. Simon, Chicago, '49
H. Solakian, New Haven, '50
A. R. Troiano, Notre Dame, '49
H. S. VanVleet, Chicago, '48
C. A. Zapffe, Baltimore, '50

#### METALS HANDBOOK COMMITTEE

J. B. JOHNSON, Chairman, '47 Wright Field Dayton, Ohio

TAYLOR LYMAN, Secretary 7301 Euclid Ave. Cleveland 3 Members:
Howard Avery, New Jersey, '49
R. M. Brick, Philadelphia, '49
E. S. Davenport, Pittsburgh, '49
E. O. Dixon, Milwaukee, '49
R. L. Kenyon, Cincinnati, '49
H. S. Rawdon, Washington, '47
Howard Scott, Pittsburgh, '49
Gordon T. Williams, Hartford, '49
N. E. Woldman, New Jersey, '48
Lyall Zickrick, A.I.M.E. Rep.
H. L. Maxwell, A.W.S. Rep.
C. W. Obert, I.A.A. Rep.
J. H. Romann, A.S.M.E. Rep.

## EDUCATIONAL COMMITTEE

C. R. AUSTIN, Chairman, '48 Meehanite Metal Corp. New Rochelle, N. Y.

RAY T. BAYLESS, Secretary 7301 Euclid Ave. Cleveland 3 Members:
G. M. Cover, Cleveland, '49
G. R. Fitterer, Pittsburgh, '48
H. L. Grange, Detroit, '50
J. G. Jackson, Philadelphia, '49
J. F. Kahles, Cincinnati, '50
H. B. Knowlton, Chicago, '49
R. D. Stout, Lehigh Valley, '48

# METAL PROGRESS ADVISORY COMMITTEE

E. E. Thum, Editor
F. B. Foley, President
H. K. Work, Vice-President
W. H. Eisenman, Secretary
Ray T. Bayless, Assistant Secretary

Members:
E. H. Dix, Jr., Pittsburgh, '48
O. W. Ellis, Toronto, '50
W. E. Jominy, Detroit, '50
M. A. Scheil, Milwaukee, '49
C. S. Smith, Chicago, '49
Earle Smith, Cleveland, '48
Jerome Strauss, New York, '49

<sup>\*</sup>The numerals following each committeeman's name indicate that his term of office on that committee expires at the close of the annual meeting of the Society of the year expressed.

# Chapters and Officers

#### AKRON CHAPTER

COLUMBUS FLOYD, Chairman, 632 Sunset View Drive, Akron, Ohio

JAMES L. OBERG, Secretary, 66 Fernwood St., Barberton, Ohio

ROBERT A. OSBORN, Treasurer, 737 No. Druidwalk, Akron, Ohio

#### BALTIMORE CHAPTER

Howes Bodfish, Chairman, 400 Baltimore Life Bldg., Baltimore

Donald W. Kalkman, Secy-Treas., 408 Evesham Ave., Baltimore

#### BIRMINGHAM CHAPTER

J. Ernest Hill, Chairman, 4917 Farrell Ave., Fairfield, Ala. Joseph P. Flood, Secy-Treas., 124 S. 16th St., Birmingham, Ala.

#### BOSTON CHAPTER

C. G. Lutts, Chairman, U.S. Navy Yard, Boston

H. E. HANDY, Secy-Treas., Saco-Lowell Shops, Biddeford, Maine

#### BRITISH COLUMBIA CHAPTER

G. L. CREIGHTON, Chairman, Heaps Engineering 1940 Ltd., New Westminster, B.C.

F. H. STEPHENS, Secy-Treas., 505 Metropolitan Bldg., Vancouver, B.C.

#### **BUFFALO CHAPTER**

E. M. GALBREATH, Chairman, 198 Parkwood Ave., Kenmore, N. Y.

J. H. Birdsong, Secretary, Buffalo Testing Labs., Inc., 37 Niagara St., Buffalo

CHARLES O. BURGESS, Treasurer, Union Carbide & Carbon Co., P. O. Box 580, Niagara Falls, N. Y.

#### CALUMET CHAPTER

R. B. Lucas, Chairman, 536 Polk St., Gary, Ind.

W. S. LIENHARDT, Secretary, Metal & Thermit Corp., 415 E. 151st St., East Chicago, Ind.

E. W. TAYLOR, Treasurer, S. G. Taylor Chain Company, P. O. Box 509, Hammond, Ind.

#### CANTON-MASSILLON CHAPTER

O. J. Horger, Chairman, Timken Roller Bearing Co., Canton, Ohio

L. A. Zeitz, Secretary, East Ohio Gas Company, Canton, Ohio

D. H. FEEZEL, Treasurer, Republic Steel Corp., Canton, Ohio

#### CEDAR RAPIDS CHAPTER

E. C. MITTVALSKY, Chairman, 1107—2nd St., S. E., Cedar Rapids, Iowa

George H. Taylor, Secy-Treas., 425 20th St., N. E., Cedar Rapids, Iowa

#### CHATTANOOGA CHAPTER

EDWIN C. WOOTEN, Chairman, 1101 Mississippi Ave., Chattanooga, Tenn.

A. D. Willis, Jr., Secretary, 2004 Lyndon Ave., Chattanooga, Tenn.

CLAUDE W. SWEENEY, Treasurer, 616 Lindsay St., Chattanooga, Tenn.

#### CHICAGO CHAPTER

Alfred S. Jameson, Chairman, International Harvester Co., 5225 South Western Blvd., Chicago

Andrew A. Engelhardt, Secy-Treas., C. H. Martin, 122 S. Michigan Ave., Chicago

#### CINCINNATI CHAPTER

W. A. Maddox, Chairman, Cincinnati Milling Machine Company, Cincinnati

A. P. Fischer, Secretary, E. F. Houghton & Co., 803 Chamber of Commerce Bidg., Cincinnati

STANTON T. OLINGER, Treasurer, Cincinnati Gas & Electric Co., P. O. Box 960, Cincinnati

#### CLEVELAND CHAPTER

WARREN A. SILLIMAN, Chairman, Oliver Corp., Euclid & E. 193rd St., Euclid, Ohio

CARL L. HARVEY, Secretary, Lamson & Sessions Co., 1971 W. 85th St., Cleveland

DENTON T. DOLL, Treasurer, Case Institute of Technology, Cleveland

#### COLUMBUS CHAPTER

WALTER HOBBS, Chairman, Ranco, Inc., Columbus, Ohio

R. E. Christin, Secretary, Columbus Bolt Works, Columbus, Ohio

James T. Gow, Treasurer, 1206 Lincoln Rd., Columbus, Ohio

#### DAYTON CHAPTER

STEWART DE POY, Chairman, Dayton Forge & Heat Treating Co., Dayton, Ohio

CHESTER L. GILLUM, Secretary, The Dayton Power & Light Co., Dayton, Ohio

James Niehaus, Treasurer, 2447 King Ave., Dayton, Ohio

#### DES MOINES CHAPTER

- P. G. PARKS, Chairman, 669 17th St., Des Moines, Iowa
- F. J. Borgstedt, Secy-Treas., 917—31st St., Des Moines, Iowa

#### DETROIT CHAPTER

- E. H. STILWILL, Chairman, 16700 Warwick Ave., Detroit
- ARTHUR H. SMITH, Secy-Treas., Cadillac Motor Car Division, Clark Ave., Detroit

#### DETROIT CHAPTER (TOLEDO GROUP)

- FRED W. LUTZ, Chairman, 2301 Cheltenham, Toledo, Ohio
- GLADWELL W. DAVISON, Secy-Treas., National Supply Co., 3320 Bishop St., Toledo, Ohio

#### EASTERN NEW YORK CHAPTER

- E. F. NIPPES, Chairman, Rensselaer Polytechnic Institute, Troy, N. Y.
- MISS MARY JANE FIELD, Secy-Treas., Room 314, Bldg. 5, General Electric Co., Schenectady, N. Y.

#### FORT WAYNE CHAPTER

- W. E. GIFFORD, Jr., Chairman, Magnavox Company, Fort Wayne, Ind.
- GEORGE JENNINGS, Secretary, 2905 Brooklyn Ave., Fort Wayne, Ind. C. A. PAYNTOR, Treasurer, Hazelhurst Drive, Eart Wayne, Ind.
- Fort Wayne, Ind.

#### GEORGIA CHAPTER

- ALVA S. WILSON, Chairman. Auto-Soler Co., 267 Marietta St., N. W., Atlanta, Ga.
- MICHAEL F. WIEDL, JR., Secretary, 267 E. Paces Ferry Rd., N. E., Atlanta, Ga.
- DeWitt G. Gunsolus, Treasurer, Eclipse Fuel Engineering Co., Room 18—267 E. Paces Ferry Rd., N. E., Atlanta, Ga.

#### GOLDEN GATE CHAPTER

- FRED I. DONLEVY, Chairman, Caterpillar Tractor Company, San Leandro, Calif.
- H. E. Krayenbuhl, Secretary, Oliver United Filters, 2900 Glascock St., Oakland, Calif.
- FRANK B. DRAKE, Treasurer, Johnson Gear & Mfg. Co., Ltd., 8th & Parker Sts., Berkeley, Calif.

## HARTFORD CHAPTER

- D. A. TULLOCK, JR., Chairman, Holo-Krome Screw Corp., Hartford
- FRANCIS J. WOLFER, Secy-Treas., 124 Tremont St., New Britain

#### INDIANAPOLIS CHAPTER

- A. J. Newsom, Chairman, Schwitzer-Cummins Co., 1125 Massachusetts Ave., Indianapolis
- J. W. WATSON, Secretary. 3424 W. Washington St., Indianapolis
- R. H. Stewart, Treasurer, 4958 W. 13th St., Indianapolis

#### INLAND EMPIRE CHAPTER

- Walter Davis, Chairman, Gonzaga University, Spokane
- WILLIAM GARSKE, Secy-Treas., N. 2527 Atlantic, Spokane

#### KANSAS CITY CHAPTER

- MILO J. STUTZMAN, Chairman, Midwest Research Institute, 4049 Pennsylvania, Kansas City, Mo.
- G. S. Young, Secy-Treas., Kansas City Power & Light Co., P. O. Box 679, Kansas City, Mo.

#### LEHIGH VALLEY CHAPTER

- R. L. Deily, Chairman, Bethlehem Steel Co., Bethlehem, Pa.
- G. A. BARKER, Secy-Treas., Bethlehem Steel Co., Bethlehem, Pa.

#### LOS ALAMOS CHAPTER

- James M. Taub, Chairman, P. O. Box 1663, Los Alamos, New Mexico
- WILLIAM W. WELLBORN, Secy-Treas., P. O. Box 1663, Los Alamos, New Mexico

#### LOS ANGELES CHAPTER

- Edgar Brooker, Chairman, U. S. Spring & Bumper Co., 4951 Alcoa Ave., Vernon, Calif.
- W. J. Parsons, Secy-Treas., Pacific Scientific Co., 1430 Grande Vista, Los Angeles, Calif.

#### LOUISVILLE CHAPTER

- B. F. HANDEL, Chairman, 3514 Hycliffe Ave., Louisville, Ky.
- F. M. KLAYER, Secy-Treas., 4147 Greenwood Ave., Louisville, Ky.

#### MAHONING VALLEY CHAPTER

- JOHN A. RITZ, Chairman,
  - Metal Carbides Corp., 107 E. Indianola, Youngstown, Ohio
- ROBERT J. SLEE, SR., Secy-Treas., 500 E. Midlothian Blvd., Struthers, Ohio

#### MANITOBA CHAPTER

- PAUL E. LAMOUREUX, Chairman, Trans-Canada Airlines, Stevenson Field, Winnipeg, Manitoba
- E. M. Evans, Secy-Treas., Pydee & Evans Engr. Co. Ltd., 1018 Sherbrook St., Winnipeg, Manitoba

MICHIGAN COLLEGE OF MINING AND TECHNOLOGY CHAPTER

FREDERICK GIESEKING, Chairman, 248 Douglass Houghton Hall, Houghton, Mich.

THEODORE E. DENNIS, Secy-Treas., Theta Tau House, 1405 College Ave., Houghton, Mich.

MILWAUKEE CHAPTER

H. H. Zabel, Chairman, Allen Bradley Co., 136 W. Greenfield Ave., Milwaukee

E. G. GUENTHER, Secy-Treas., Wisconsin Motor Corp., Milwaukee

MISSOURI SCHOOL OF MINES AND METALLURGY CHAPTER

Joseph C. Vogt, Chairman, 1308 Elm St., Rolla, Mo.

JOSEPH D. ALLEN, Secretary, MSM Apt. T-4, Rolla, Mo.

ROGER E. NOWLIN, Treasurer, Concordia, Mo.

MONTREAL CHAPTER

E. A. DeJean, Chairman, L. DeJean & Co., Ltd., Montreal, P. Q.

MRS. B. W. McGILLIVRAY, Secretary, P.O. Box 371—Station 'H', Montreal, P.Q.

K. J. Barwick, Treasurer, Henderson-Barwick Co., Ltd., Montreal, P. Q.

MUNCIE CHAPTER

WALTER McCORMACE, Chairman, R. R. No. 1, Spiceland, Ind.

Dallas Lunsford, Secy-Treas., Perfect Circle Company. Box 191, New Castle, Ind.

NEW HAVEN CHAPTER

HAIG SOLAKIAN, Chairman, A. F. Holden Company, New Haven

H. C. IRVING, Secretary, Bridgeport Brass Co., Bridgeport

MICHAEL KOBER, Treasurer, Commercial Metal Treating Co., 89 Islandbrook Ave., Bridgeport

NEW JERSEY CHAPTER

WILLIAM KLAILE, Chairman, 78 Midland Place, Newark, N. J.

HENRY F. J. SKARBEK, Secretary, 2038 Pleasant Parkway, Union, N. J.

R. W. THORNE, Treasurer, Bennett Insured Steel Treating Co., 246 Raymond Blvd., Newark, N. J. NEW YORK CHAPTER

D. E. Boyd, Chairman, Jos. T. Ryerson & Son, Inc., Jersey City, N. J.

HAROLD M. MALM, Secretary, Little Falls Alloys, Inc., 189 Caldwell Ave., Paterson, N. J.

GEORGE A. SANDS, Treasurer, Electro Metallurgical Co., 30 E. 42nd St., New York, N. Y.

NORTH TEXAS CHAPTER

Leon L. Sanders, Chairman, 2005 Montgomery St., Fort Worth, Texas

A. L. LA BOUNTY, Secy-Treas., 2916 No. Houston St., Fort Worth, Texas

NORTH WEST CHAPTER

WALTER E. SWEET, Chairman, Twin City Steel Treating Co., Minneapolis

LILLIAN K. POLZIN, Secy-Treas., Minneapolis Chamber of Commerce, 100 Pillsbury Bldg., Minneapolis

NORTHWESTERN PENNSYLVANIA CHAPTER

CARL E. BLASS, Chairman, Talon, Inc., Meadville, Pa.

ROBERT L. CATLIN, Secy-Treas., 145 Wright St., Corry, Pa.

NOTRE DAME CHAPTER

RALPH D. WYSONG, Chairman, Studebaker Corp., 2002 Mishawaka Ave., South Bend, Ind.

E. G. Mahin, Secretary,
Dept. of Metallurgy,
University of Notre Dame,
Notre Dame, Ind.

H. J. McLellan, Treasurer, University of Notre Dame, 2605 Erskine Blvd., South Bend, Ind.

OAK RIDGE CHAPTER

ROBERT W. COYLE, Chairman, 102 Packer Rd., Oak Ridge, Tenn.

FRED WM. DROSTEN, Secretary, 102 Darwin Rd., Oak Ridge, Tenn.

FRANK J. LAMBERT, JR., Treasurer, 116 Ogantz Lane, Oak Ridge, Tenn.

ONTARIO CHAPTER

W. S. CRAIG, Chairman, Stamped & Enamelled Ware Ltd., Hespeler, Ont., Canada

G. Frank Knight, Secretary, Railway & Power Engr. Corp. Ltd., 43-45 King William St., Hamilton, Ont.

H. THOMASSON, Treasurer, 162 Rothsay Ave., Hamilton, Ont.

#### OREGON CHAPTER

REX DELONG, Chairman, 4020 N. E. Wistaria Drive, Portland, Oregon

A. C. Woolley, Secy-Treas., 1869 S. W. Broadway, Portland, Oregon

#### OTTAWA VALLEY CHAPTER

Molson Hannaford, Chairman, 3829 North Cliffe Ave., Montreal, Que.

N. B. Brown, Secretary, 31 Orrin Ave., Ottawa, Ont.

Douglas A. Tetu, Treasurer, Bureau of Mines & Resources, Ottawa, Ont.

#### PENN STATE CHAPTER

F. CLIFTON WAGNER, Chairman, Division of Metallurgy, Pennsylvania State College, State College, Pa.

D. F. McFarland, Secy-Treas., Division of Metallurgy, Pennsylvania State College, State College, Pa.

#### PEORIA CHAPTER

T. M. Logan, Chairman, 307 E. McClune, Peoria, Ill.

WILLIAM E. FRANK, Secy-Treas., 161 North Eleanor, Peoria, Ill.

#### PHILADELPHIA CHAPTER

HOWARD H. CASEY, JR., Chairman, Camden Forge Co., Mt. Ephraim Ave., Camden, N. J.

FREDERICK COOPER, Secretary, 107 Woodside Ave., Narberth, Pa.

George J. Kaiser, Treasurer, Penn. Forge Corp., Milnor & Bleigh Sts., Tacony, Philadelphia

#### PITTSBURGH CHAPTER

HAROLD T. CLARK, Chairman, Jones & Laughlin Steel Corp., Pittsburgh

H. L. WALKER, Secretary, Box 6621, N. S. Sta., Pittsburgh

H. C. Amtsberg, Treasurer, 1743 Jamestown Place, Pittsburgh

#### PUGET SOUND CHAPTER

H. P. Evans, Chairman, Boeing Aircraft Company, Seattle

C. R. Jackson, Secy-Treas., E. F. Houghton & Co., 518 First South, Seattle

#### PURDUE CHAPTER

HARROLD J. BATES, Chairman, 322 Forest Hills Drive, W. Lafayette, Ind.

HAROLD M. GRAVES, Secy-Treas., Indiana Gas & Water Co., Inc., 5th & Columbia Sts., Lafayette, Ind.

#### RHODE ISLAND CHAPTER

HENRY J. HAMEL, Chairman, 53 Welfare Ave., Cranston, R. I.

ARTHUR S. JOHNSON, Secy-Treas., 227 Washington St., Lakewood, R. I.

#### ROCHESTER CHAPTER

CHARLES E. VAUGHN, Chairman, Ritter Dental Mfg. Company, Rochester, N. Y.

N. J. FINSTERWALDER, Secy-Treas., Taylor Instrument Co., 95 Ames St., Rochester, N. Y.

#### ROCKFORD CHAPTER

Everett Magnuson, Chairman, Eclipse Fuel Engineering Co., 711 So. Main St., Rockford, Ill.

H. E. HABECKER, Secy-Treas., Mattison Machine Works, Rockford, Ill.

# ROCKY MOUNTAIN CHAPTER (DENVER GROUP)

J. L. Higson, Chairman, 350 Jersey St., Denver

J. F. Musgrove, Secretary, Denver, Rio Grande & Western R.R. Co., Denver

JAMES COLASANTI, Treasurer, 4175 Green Court, Denver

# ROCKY MOUNTAIN CHAPTER (PUEBLO GROUP)

IRVING HERTS, Chairman, Colorado Fuel & Iron Corp., Pueblo, Colo.

C. J. VIDMAR, Secy-Treas., 311 Bennett Drive, Pueblo, Colo.

#### ROME CHAPTER

R. Carson Dalzell, Chairman, Revere Copper & Brass, Inc., Rome, N. Y.

I.. H. DECKER, Secy-Treas., Revere Copper & Brass, Inc., Research Dept., Rome, N. Y.

#### SAGINAW VALLEY CHAPTER

M. J. Caserio, Chairman, 3709 Brunswick, Flint, Mich.

H. A. Maloney, Secy-Treas., 1902 Colchester Rd., Flint, Mich.

#### ST. LOUIS CHAPTER

R. C. TITTEL, Chairman, Owens-Illinois Glass Co., Alton, Ill.

Lester W. Morrell, Secy-Treas., Revere Copper & Brass, Inc., Dallas Division, 3908 Olive St., St. Louis, Mo.

#### SAN DIEGO CHAPTER

C. W. Alesch, Chairman, 3481 Pickett, San Diego, Calif.

EARL A. Kops, Secretary, 2956 'C' St., San Diego, Calif.

RALPH V. HILKERT, Treasurer, 3578 44th St., San Diego, Calif.

#### SOUTHERN TIER CHAPTER

Walter G. Baird, Chairman, 5 Hotchkiss Ave., Hillcrest, R. D. 3, Binghamton, N. Y.

James S. Meyer, Secy-Treas., International Business Machines Corp., Endicott, N. Y.

#### SPRINGFIELD CHAPTER

DANIEL J. CLINI, Chairman, 30 Belmont Ave., Springfield, Mass.

JOSEPH A. TINSMAN, Secy-Treas., 208 Maple St., East Longmeadow, Mass.

#### SYRACUSE CHAPTER

R. N. Gillmor, Chairman, General Electric Co., Syracuse, N. Y.

WALTER HODAPP, Secretary, Crucible Steel Co., Syracuse, N. Y.

JOHN T. MITCHELL, Treasurer, New Process Gear Corp., Syracuse, N. Y.

#### TERRE HAUTE CHAPTER

KENNETH E. HAZLEDINE, Chairman, E. T. Hazledine Co., 231 So. 1st St., Terre Haute, Ind.

M. E. HANSELL, Secretary, Rose Polytechnic Inst., Terre Haute, Ind. STEPHEN REYNOLDS, Treasurer, 2360 Seabury Ave., Terre Haute, Ind.

#### TEXAS CHAPTER

K. P. CAMPBELL, Chairman, Sheffield Steel Corp., Houston, Texas

H. C. DILL, Secy-Treas., 3815 Arnold St., Houston, Texas

# TRI-CITY CHAPTER

FRANK T. O'CONOR, Chairman, American Machine & Metals, East Moline, Ill.

James C. Erickson, Secy-Treas., John Deere Plow Works, Moline, Ill.

#### TULSA CHAPTER

DALE L. HALL, Chairman, Oklahoma Steel Castings Co., 1200 N. Peoria, Tulsa, Okla.

VIRGIL V. VEACH, Secy-Treas., 424 So. 48th W. Ave., Tulsa, Okla.

# VIRGINIA POLYTECHNIC INSTITUTE CHAPTER

C. M. Hollyfield, Chairman, Dept. of Metallurgy, Box 336, Blacksburg, Va.

HENRY T. GREGG, Secy-Treas., Dept. of Metallurgy, Box 336, Blacksburg, Va.

#### WARREN CHAPTER

I. A. OEHLER, Chairman, American Welding & Mfg, Company, Dietz Rd., Warren, Ohio

R. E. GOODMAN, Secy-Treas., American Welding & Mfg. Co., Warren, Ohio

#### WASHINGTON CHAPTER

A. W. Mace, Chairman, Allegheny Ludlum Steel Corp., 1001 15th St., N. W., Washington, D. C.

F. M. REINHART, Secy-Treas., National Bureau of Standards, Room 105 N. W. Bldg., Washington, D. C.

#### WEST MICHIGAN CHAPTER

WM. J. JABSEN, Chairman, 150 Blaine St., Kalamazoo, Mich.

RAY CROSS, Secretary, 510 Northwood N. E., Grand Rapids, Mich.

E. R. Goop, Treasurer, R. R. No. 3, E. Good St., S. E., Grand Rapids, Mich.

#### WESTERN ONTARIO CHAPTER

Howard J. Wright, Chairman, Quality Steels Canada Ltd., 529 Philip St., London, Ont.

J. Roy Toll, Secretary, Webster Air Equipment Ltd., 140 Ann St., London, Ont.

RAYMOND E. BARTON, Treasurer, Canadian Mines Equipment Ltd., 596 Hamilton Rd., London, Ont.

#### WICHITA CHAPTER

L. A. Hibbs, Chairman, Coleman Company, Inc., Wichita, Kansas

James W. Haupt, Secretary, 1006 Amidon, Wichita, Kansas

ELDON A. MEANS, Treasurer, P. O. Box 2012, Wichita, Kansas

#### WORCESTER CHAPTER

LLOYD FIELD, Chairman, Greenman Steel Treating Co., Worcester, Mass.

HILDING A. EDBERG, Secy-Treas., Progressive Tool & Die Co., Worcester, Mass.

#### YORK CHAPTER

A. R. KUNKLE, Chairman, York Ice Machinery Corp., York, Pa.

R. F. VINES, Secretary, Dentists' Supply Co., York, Pa.

GLENN FRANK, Treasurer. R. D. No. 1, Camp Hill, Pa.